

## THE INFLUENCE OF TEMPERATURE ON MIGRATION

BY JOHN S. MAIN

In studying the spring migration of birds it is interesting to consider the influence of the weather as affecting the time of their arrival, either at their final destination or at any given point along the way.

At the outset questions arise: What part does the weather play in initiating the northward movement? What part does temperature play? Assuming that a rising temperature at the proper season encourages migration, how high must it rise above normal in order to become effective? Does abnormally warm weather at the starting point cause an abnormally early departure? Does the temperature that prevails in the region toward which the birds are traveling affect the time of their arrival?

Most of these questions have already been discussed at length and have perhaps been answered as definitely as it will ever be possible to do, but unusual conditions arise from time to time which illustrate the play of cause and effect and help to confirm our opinions if they do not add greatly to our knowledge. Such is the case with certain events of the past two winters (1929-30 and 1930-31) and it is the striking contrast afforded by them which forms the subject of this paper.

Speaking for the vicinity of Madison, Wisconsin, where the writer resides, weather conditions during the winter of 1929-30 were, for the most part, in no way remarkable. There were fifteen sub-zero days, seven of them being  $-11^{\circ}$ , or more. Once it reached  $-20^{\circ}$ , and again  $-24^{\circ}$ . The mean temperature for December and January was  $2^{\circ}$  below normal; from February 1 to 18 it was  $4^{\circ}$  above normal. On the latter date, however, a decided change took place. The mercury rose rapidly. On the 19th it reached  $56^{\circ}$  above zero, on the 20th,  $57^{\circ}$ , on the 21st,  $60^{\circ}$ . For five successive days the maximum all-time heat records were broken, the week ending February 25 showing a mean temperature of  $28^{\circ}$  above normal!

How did this affect migration? Let us take for examples the Bluebird, Robin, Meadowlark, Bronzed Grackle, and Killdeer, which, with the Red-winged Blackbird and Song Sparrow are the first of the small birds to arrive. Bluebirds and Killdeers appeared February 21, Robins and Meadowlarks on February 22, and Bronzed Grackles on February 26. None of these birds ordinarily arrive much before March 10, and the dates above given are, with one or two possible exceptions in the case of the Bluebird, from a week to ten days earlier

than any previous records. It may be added that on February 24 several Song Sparrows and two flocks of redwings were seen, together with large numbers of Herring Gulls, mergansers, golden-eyes, Mallards, Black Ducks, Pintails, and Coots, affording abundant evidence of a widespread movement into this area during that week. For the purpose of this study, I am confining myself to the five species first named because of the fact that, with rare exceptions, none of them winter in this region and the first individuals seen in the spring can

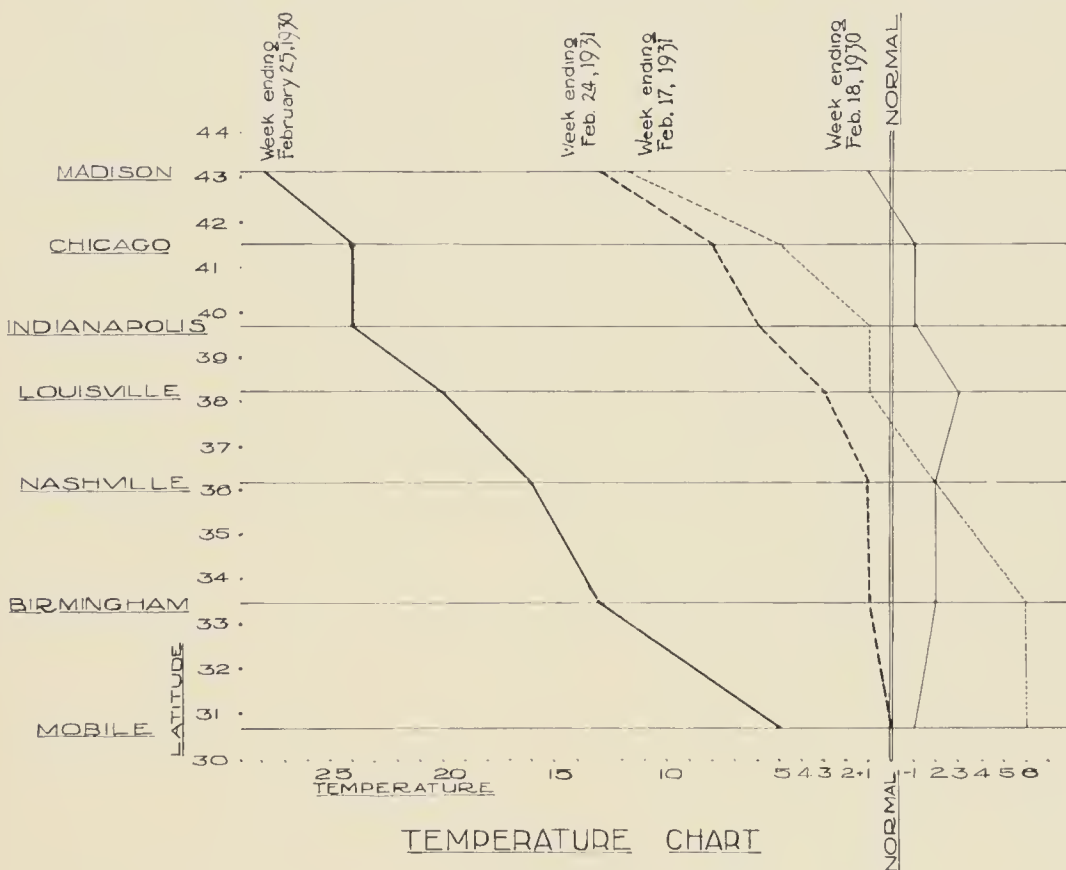


FIGURE 5.

be assumed to be migrants, especially if two or more individuals of a species are observed in different localities on the same day.

Let us now turn to the winter just passed, that of 1930-31. It was indeed a very exceptional one. There were only five sub-zero days. The coldest was  $-4^{\circ}$ , setting an all-time record; the mean temperature for December, January, and February was the highest in 41 years; *the month of February was the warmest in 49 years*. February, moreover, was entirely free of storms, the weather generally fair, the ground bare of snow. In brief, conditions more favorable to migration could hardly be imagined.

With this state of affairs existing it might reasonably be expected that there would be an unusually early return of the first migrants, as

occurred in February of the previous year. On the contrary, of the five species first mentioned three did not appear until the first week in March, and the others not until the second week, the dates being as follows: Robins, March 4; Bronzed Grackles, March 6; Meadowlarks, March 7; Killdeers, March 9; Bluebirds, March 12. While somewhat earlier than usual, these dates were, on the average, *two weeks later than the arrival dates in 1930*. What is the explanation?

The answer to this, and possibly to the other questions raised in the opening paragraph of this article, will, I believe, be found in the sub-joined chart, which pictures for each year the conditions that prevailed in the regions to the southward during the period referred to. It shows that in both 1930 and 1931 substantially normal temperatures prevailed during the week ending February 18. In 1931 the temperatures for the succeeding week were only a little above normal throughout the wintering range. In 1930, however, the conditions were strikingly different. As shown by the chart, the temperatures during the week in question were excessively high all the way from Madison to the Gulf—so high as to incite the birds to an abnormally early departure and also to hasten the progress of their journey.

The various cities named on the chart were selected merely to show the temperatures that prevailed in certain areas, not to indicate any definite migration route. Indianapolis, for instance, has approximately the latitude of Springfield, Illinois, and their temperatures were much the same. Similarly, Mobile is made the southern terminus of the graph for the purpose of showing the extent of the warm wave of 1930, not to suggest that any of these migrants started from there. It is, however, probable that the Bluebirds and Meadowlarks wintered that year as far south as southern Illinois, while the Killdeer, Bronzed Grackles, and even the Robins may have come from Kentucky or Tennessee.

The distance covered within the week would probably be 250-450 miles, indicating a much more rapid rate of travel than has commonly been assumed for the early migrants.

All temperature records on the chart are taken from U. S. Weather Bureau reports.

MADISON, WISCONSIN.